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EDITORIAL COMMENT

Cardiac Magnetic Resonance in the World of the Cardiac Electrophysiologist

The Road to Real-Time Cardiac Magnetic Resonance*

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Atrial fibrillation (AF) is the most common cardiac arrhythmia (1) with significant morbidity and mortality (2). A significant milestone in the treatment of AF was achieved by introducing catheter-based ablation (3–5). For the last decade various approaches and technologies have evolved aimed at improving and refining the ablative treatment of AF.

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Electrical isolation of pulmonary veins with radiofrequency (RF) ablation has now been widely accepted for treatment of AF in which single antiarrhythmic medication has failed (6). RF has also been shown to maintain long-term sinus rhythm in chronic AF (7). Isolation of pulmonary veins with RF catheter ablation of pulmonary veins has an encouraging success rate (7,8). The recurrence of AF has been associated with incomplete pulmonary vein isolation and the existence of triggers beyond the pulmonary veins (9,10). Despite many exciting novel approaches, electrical isolation of the pulmonary veins by applying circumferential lesions around their antra remains the most widely accepted ablation strategy.

Multiple ablation technologies, modalities, and energy sources have also been studied to achieve 2 main goals: delivery of an appropriate transmural lesion to avoid recurrent arrhythmias and collateral damage post-ablation and improvement of navigation within the left atrial cavity to facilitate adoption of the procedure in the electrophysiology (EP) lab. In this issue of *iJACC*, Peters et al. (11) describe an interesting imaging modality based on 3-dimensional delayed-enhancement cardiac magnetic resonance (CMR) to track ablation lesions post-ablation of AF in an elegantly conducted study. The authors confirm findings from our group that suggest that more lesions correlate with better outcome (12). Thirteen (37%) patients had recurrent AF during the 6.7 ± 3.6 month observation period. The volume of scar in the right inferior pulmonary vein (RIPV) was quantitatively greater in patients *without* recurrence ($p = 0.049$). Qualitatively, patients without recurrence had more circumferentially scarred veins ($p = 0.036$). They use the expression "lynch pin" to express their findings. The RIPV is always a major challenge during an ablation procedure. This could be attributed to its vicinity to the transseptal puncture site that might lead to impaired tissue catheter interface and stability of the ablation catheter during ablation. The authors also describe merging the 3-dimensional lesions model with the pre-acquired 3-dimensional CMR model. This would be a helpful tool to locate the site of the lesions, but it might have been more accurate if the lesions were segmented as a part of the left atrial tissue as described by McGann et al. (12). Although this study shows scar volume of RIPV isolation predicts recurrence, these results must be interpreted with caution due to the small sample size.

In the last decade, a great deal of effort has been invested in improving tools and imaging modalities that would help navigation within the left atrial chamber (13,14). Recently Nazarian et al. (15) reported the feasibility of real-time CMR-guided EP procedures (15) and Dukkipati et al. (16)

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described a novel electroanatomical mapping CMR-guided EP procedure. Until recently, no major focus has been dedicated toward detection and monitoring of left atrial tissue damage acquired during ablation. Our group and others recently introduced 3-dimensional CMR-based methods to detect and monitor lesions after an AF ablation procedure (11,12,17). The visualization of left atrial lesion formation and depth as it forms represents an important first step on the road to "real-time CMR for AF ablation." Achievement of this goal would also be furthered by the interdisciplinary cooperation between radiologists and electrophysiologists. Such a model has already proven successful at our, and many other, institutions.

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Key Words: cardiac electrophysiology ■ cardiac magnetic resonance ■ ablation.